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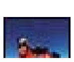

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from the August 05, 2004 edition

PARTICLE MAN: Atmospheric chemist Barkley Sive collects data that will determine how ocean air affects air pollution that the US exports to Europe.
PETER N. SPOTTS

Blowing in the wind: transatlantic pollution

By Peter N. Spotts | *Staff writer of The Christian Science Monitor*

APPLEDORE ISLAND, MAINE – Jochen Stutz welcomes a visitor to his enclosed concrete perch five stories above Appledore Island - a speck of rock and scrub that is one of several tightly packed islands making up the Isles of Shoals, six miles east of Kittery, Maine.

Most folks come to these islands for the sun, sea, and solitude. Dr. Stutz comes for the air pollution.

"Here, you get what comes from Boston and New York," the atmospheric chemist from the University of California at Los Angeles explains as he tends an instrument that measures airborne pollutants. "The Isles of Shoals are right in the path."

Dr. Stutz and a handful of colleagues at this outpost represent one element in an unprecedented international effort this summer to study regional and transatlantic air pollution and its potential effect on climate. The immediate goal is to provide information that will improve daily air-pollution

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forecasts from Boston to Brussels and give climate scientists a better idea of how pollution from North America directly and indirectly alters the amount of heat the atmosphere retains from the sun.

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Inadvertently, however, the research also may build a case for international cooperation in combating air pollution.

The work is critical to setting emissions standards, says Daniel Jacob, an atmospheric chemist at Harvard University. Otherwise, "you could find that your efforts are being defeated by ozone pollution" from somewhere else.

Within the past five years, scientists have grown to appreciate the globe- trotting nature of ozone in the lower atmosphere and of tiny particles called aerosols, says Dr. Jacob, a member of the international research effort known as the International Consortium for Atmospheric Research on Transport and Transformation (ICARTT).

Researchers have found, for example, that air pollution from Asia can further undermine air quality in spots such as Sequoia and Kings Canyon national parks in California - "pristine" spots already affected by the Golden State's own air-quality problems. European air pollution has been tracked to Asia and the Arctic. Now, scientists are trying to close a knowledge gap on both sides of the Atlantic.

This summer's project began as a more modest effort to study air pollution in the northeast United States, notes Fred Fehsenfeld, an atmospheric chemist at the National Oceanic and Atmospheric Administration's Aeronomy Laboratory in Boulder, Colo.

In the summer of 2002, researchers from NOAA, the University of New Hampshire, and several other universities conducted a month-long air-pollution study using data from ground-based measuring sites, aircraft, and NOAA's research vessel, the Ronald H. Brown. This effort uncovered new and critical elements to the region's air-pollution problems.

Even as the 2002 campaign was being planned, researchers were looking ahead to a similar effort this year to follow up on 2002's expected discoveries. NOAA's 2004 project became the nucleus around which a broader research agenda condensed. While NOAA is still pursuing the US regional problem, scientists outside NOAA couldn't pass up a chance to make complementary, simultaneous measurements that would allow them to ask deeper questions about the atmosphere, its climate, and its chemistry. A regional US research project mushroomed as atmospheric scientists filed in from the National Aeronautics and Space Administration, the US Department of Energy, the US Navy, and a broad range of universities in the US, Canada, Germany, France, and Britain. "If you build it, they will come," Dr. Fehsenfeld says with a grin.

A research "air force" that consisted of one plane in 2002 has grown to roughly a dozen aircraft - ranging from a futuristic single-seater designed by aviation pioneer Burt Rutan to an intercontinental NASA DC-8. The craft fly from bases in New Hampshire, Canada, Europe, and the Azores. Researchers are able to fly through and measure plumes of polluted air that flow from the American heartland, out over the Atlantic, and across to Europe. By combining data from balloons, satellites, and from ship- and land-based sensors, scientists say they are optimistic they can unravel the complex interplay between weather, time of day, and unique chemistry in air over the ocean as they alter pollution plumes that migrate east.

Researchers say that, compared with the Pacific, air pollution behaves differently over the Atlantic. Pollution coming from Asia tends to rise to the higher reaches of the troposphere - the lowest layer of Earth's atmosphere - before it moves east. At those altitudes, air forms relatively stable layers that can trap and carry pollutants in broad plumes for thousands of miles.

In contrast, a significant portion of eastbound air pollution from North America hangs much closer to the surface of Earth within what is called the boundary layer. Scientists are divided on how much transpacific pollution directly affects air quality at human heights. But pollution traveling in the Atlantic's so-called marine boundary layer has a much more direct impact.

Yet the air in the marine boundary layer holds a different mix of chemicals from its landlubber counterpart. These chemicals, derived largely from salts and other compounds in seawater, can stimulate the generation of ozone or destroy it. In some cases, the same compound can do both. The interplay of these reactions over the ocean is less well understood than for land-based ozone pollution, and are a key target for the ICARTT study.

Of particular interest is what Fehsenfeld calls "the dark side of the force" - nighttime chemistry in the air over the ocean that can destroy ozone as well as morph it into a compound that acts as a reservoir for a new plume of pollution the next day. No one is sure which of the two types of reaction dominates.

In addition, researchers are keenly interested in the role large-scale weather fronts can play in transporting ozone and aerosols to the upper troposphere. These fronts "seem to be a natural pumping mechanism" for lofting pollution high into the troposphere, where it can be transported for long distances, Fehsenfeld says.

Here on Appledore Island, researchers are focusing on marine-air chemistry and the formation of aerosols from sea foam and other marine sources. Air-sampling gear and spectrometers occupy several floors and the roof of a seven-story concrete observation tower built during World War II to spot German U-boats. The tower is now part of the Shoals Marine Laboratory on the island.

In particular, the Appledore team is interested in how marine sources of bromine, chlorine, and iodine affect the ozone and aerosols, says Ruth Varner, a research professor at the University of New Hampshire.

In addition to their role in cloud formation, aerosols can reflect sunlight or absorb and reradiate it as heat, depending on their size and composition. They also can serve as tiny platforms on which important ozone-related reactions can occur.

One phenomenon the scientists are exploring is the role marine algae - especially kelp - play in forming aerosols. The trait was first discovered along the Irish coast and reported in the journal Nature in

2002. There, seaweed gave off vapors containing iodine, which under sunlight formed aerosols. Similar sources have been found in Tasmania. "We want to find out if these are isolated cases, or whether they happen everywhere," says Alexander Pszenny, another atmospheric chemist from the University of New Hampshire.

Researchers have suggested that if emissions from algae are widespread, they could have a significant effect on cloud formation - hence on climate.

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